Impact of retrograde transillumination while securing the airway in obese patients undergoing bariatric surgery

Godoroja, Daniela D ; Copaescu, Catalin A ; Agache, Mihaela C ; Biro, Peter

Abstract: Video laryngoscopy (VL) is a well-established technique used in anaesthetising obese patients who present with higher risks of airway-related difficulties and desaturations due to shorter safe apnoea periods. However, VL has certain limitations and may fail. We present the Infrared Red Intubation System (IRRIS), a new technique facilitating glottis identification in severely obese patients undergoing anaesthesia for bariatric surgery. This single-centre, prospective trial assessed the efficacy of the IRRIS for VL tracheal intubation in 20 severely obese adult patients undergoing elective bariatric surgery under general anaesthesia. We assessed the ability of the IRRIS to differentiate the transilluminated glottis from the oesophagus and laryngeal folds and evaluated the ease of intubation. The average weight in the investigated patient cohort was 145 ± 29 kg, the suprasternal tissue thickness was 12 ± 4 mm. The median IQR [range] larynx recognition time was 10 [2–50] s, which was similar to that of lean patients. The degree of obesity correlated with the duration to achieve optimal laryngoscopic view and complete the intubation procedure. We achieved successful VL insertion on the first attempt in 13 of 20 cases (65%), and on the second attempt in 7 cases (35%), emphasising the increased probability of successful intubation on the first attempt. Tracheal intubation with the IRRIS lasted 50 [IQR 20–100] s. The lowest SpO2 during intubation was 98 [IQR 83–100] %. Addition of IRRIS to VL insertion facilitated the intubation of difficult airways in severely obese patients. IRRIS improves the visualization of the intubation pathway by selectively highlighting the airway entrance and shortens the time to successfully conclude the intubation procedure.

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Impact of retrograde transillumination while securing the airway in obese patients undergoing bariatric surgery

Daniela D GODOROJA [1] *, Catalin A COPAESCU [2], Mihaela C AGACHE [3], Peter BIRO [4]

[1]Assistant Professor, Consultant, Department for Anaesthesia, Ponderas Academic Hospital, Regina Maria, Bucharest, Romania

[2]Professor, Consultant, Department for General Surgery, Ponderas Academic Hospital, Regina Maria, Bucharest, Romania

[3]Consultant, Department for Anaesthesia, Ponderas Academic Hospital, Regina Maria, Bucharest, Romania

[4]Professor and Senior Consultant, Institute of Anaesthesiology, University Hospital Zurich, Switzerland

Corresponding Author: Daniela D Godoroja, Department for Anaesthesia and Intensive Care, Ponderas Academic Hospital, Nicolae Caramfil Street, 85A, 014412, Bucharest, Romania. E-mail: daniela.godoroja@reginamaria.ro

ABSTRACT

BACKGROUND: Video laryngoscopy (VL) is a well-established technique used in anaesthetising obese patients who present with higher risks of airway-related difficulties and desaturations due to shorter safe apnoea periods. However, VL has certain limitations and may fail. We present the Infrared Red Intubation System (IRRIS), a new technique facilitating glottis identification in severely obese patients undergoing anaesthesia for bariatric surgery.

METHODS: This single-centre, prospective trial assessed the efficacy of the IRRIS for VL tracheal intubation in 20 severely obese adult patients undergoing elective bariatric surgery under general anaesthesia. We assessed the ability of the IRRIS to differentiate the transilluminated glottis from the oesophagus and laryngeal folds and evaluated the ease of intubation.

RESULTS: The average weight in the investigated patient cohort was 145 ± 29 kg, the suprasternal tissue thickness was 12 ± 4 mm. The median IQR [range] larynx recognition time was 10 [2-50] s, which was similar to that of lean patients. The degree of obesity correlated with the duration to achieve optimal laryngoscopic view and complete the intubation procedure. We achieved successful VL insertion on the first attempt in 13 of 20 cases (65%), and on the second attempt in 7 cases (35%), emphasising the increased probability of successful intubation on the first attempt. Tracheal intubation with the IRRIS lasted 50 [IQR 20-100] s. The lowest SpO_2 during intubation was 98 [IQR 83-100] %.

CONCLUSION: Addition of IRRIS to VL insertion facilitated the intubation of difficult airways in severely obese patients. IRRIS improves the visualization of the intubation pathway by selectively highlighting the airway entrance and shortens the time to successfully conclude the intubation procedure.

Key words:
video laryngoscopy, retrograde transillumination, bariatric surgery

Introduction

Video laryngoscopy (VL) is a well-established, widespread, and routine practice in anaesthesia. It is represented in the ASA Guidelines for Management of the Difficult Airway[1] as well as in the Difficult Airway Society's guidelines.[2] Both guidelines recommend VL as a default technique for anticipated difficult airway situations. Obese patients and, even more so, the morbidly obese population present a higher risk for airway-related difficulties and complications in anaesthesia.[3] A meta-analysis claimed that there was a three-fold higher incidence of difficult intubation in these patients.[4] However, obesity alone is not a strong predictor for difficult intubation, and conventional direct laryngoscopy (DL) is suitable in most morbidly obese patients.[5] Nevertheless, many studies reported that VL required fewer intubation attempts than standard DL in these patient categories.[6,7,8] By improving the glottic view, primary use of VL may increase the probability of a successful intubation on the first attempt, thus reducing the risk for hypoxemia and other airway-related morbidities. VL enhances the visualisation of the airway anatomy, and allows the intubating and assisting personnel to recognize the passage of the tracheal tube. However, a good laryngeal exposure does not mean easy introduction of the tracheal tube into the airway. DL is often the standard intubation procedure but VL might be chosen for the initial intubation attempt if the patient has a recognised increased risk of difficult intubation, or it might be considered as a backup when DL fails.[9]

However, VL has certain limitations when performed by less experienced users. Several adjunct instruments and helpful manoeuvres have been suggested to improve its performance.[10,11] A recent alternative approach is retrograde transillumination, in which near-infrared light is applied on the anterior surface of the neck, which in turn, produces a distinctive blinking light within the tracheal lumen on the VL screen.[12,13] The technique presented herein, which involves the use of the Infrared Red Intubation System (IRRIS) (Guide In Medical, Nazareth, Israel), is a recent revival of retrograde transillumination that utilises a scope to discriminate the glottis from its surrounding anatomical structures. This is achieved by increasing the contrast between the pharyngeal structures (which remain dark) and the laryngeal inlet (which becomes highlighted). The IRRIS device is CE-marked and FDA-approved. It is the size of a matchbox and is placed on the skin of the anterior neck, cranial to the sternal notch and caudal to the thyroid cartilage, preferably on the skin covering the cricothyroid membrane. The IRRIS is fixed in position with adhesive strips on both sides.

Upon activation, the IRRIS emits a specific near-infrared (NIR) light at a wavelength between 730 nm and 1000 nm with varying intensity, which penetrates all the tissues of the

anterior neck region beneath the device. The novelty of the IRRIS is that it exclusively highlights the glottic opening, whereas all other structures remain dark. The emitted light from the IRRIS is infrared and therefore invisible to the naked eye. IRRIS can be employed only with VL in which no infrared filter is included. The main purpose of this feature is to distinguish the airway from the oesophagus as well as from adjacent structures or mucosal folds that could represent a 'false passage' for the advancement of the tracheal tube. The IRRIS device can be used with various commercial VL devices in which the infrared light is not filtered, such as the KingVision^{TM} VL (Ambu A/S, Baltorpbakken 13, 2750 Ballerup, Denmark).

The tissue mass that must be transilluminated by the IRRIS is larger in obese patients than in lean patients, and it is not yet clear whether this might represent a limitation to the applicability and usefulness of this auxiliary technique. The purpose of this study was to assess the impact of the IRRIS on the performance of VL in obese patients, in whom the amount of tissue that has to be penetrated by the NIR light is far larger than in lean individuals.

Materials and methods

From May to July 2018, we recruited 20 thoroughly informed and consenting adult patients, who were scheduled for elective laparoscopic bariatric surgery under general anaesthesia via tracheal intubation, at the Ponderas Academic Hospital Centre of Excellence for Bariatric and Metabolic Surgery in Bucharest, Romania. We employed VL using the KingVision^{TM} with disposable channelled blades under retrograde transillumination with the IRRIS device. The study was approved by the Ponderas Hospital research ethics committee (Ref. 08/02/2018,), and written informed consent was obtained from all patients prior to their enrolment.

All included patients were classified as obese as defined by the World Health Organization (WHO): an excessive accumulation of fat presenting a risk to health, which can be quantified by body mass index (BMI). WHO Class 1 obesity is defined as a BMI of 30 to 35 kg/m^2, Class 2 as a BMI of 35 to 40 kg/m^2, and Class 3 as a BMI of $\geq$ 40 kg/m^2. WHO Class 3 was previously termed as 'morbid' obesity but has been recently renamed as 'extreme' obesity.

Inclusion criteria were age >18 years and an ASA physical status of 1 to 3. We excluded pregnant women, emergency cases, and patients with pre-existing airway pathologies that were not obesity-related. We recorded age, weight, height, body mass index (BMI), sex, neck circumference (NC), and SpO_2 under spontaneous breathing of room air. Using ultrasound

(US) imaging, we documented the patients' neck tissue thickness at the level of the cricothyroid membrane and this was measured in millimetres.

We scored all patients for prevalence and severity of obstructive sleep apnoea with the Anthropometric-Obstructive Sleep Apnoea (A-OSA) score.[14] This includes STOP-Bang, BMI, neck circumference, body shape index (ABSI), waist circumference, baseline SpO_2, and expiratory reserve volume (ERV). According to our local hospital protocol, we prescribed preoperative CPAP treatment if the A-OSA score was >3.

The study was conducted and supervised by one operator who was experienced with VL (DG). The airway was managed exclusively by anaesthesiologists with >2 years of professional experience and familiarity with the KingVision™ video laryngoscope.

Prior to inducing anaesthesia, an activated IRRIS device was attached to the skin of the anterior neck at the level of the cricothyroid membrane and fixed with adhesive strips. The cricothyroid membrane was identified by palpation and verified with US. We also employed US to measure the tissue thickness above the subglottic region. After confirming a lack of discomfort, anaesthesia was commenced according to our local protocol for obese patients featuring low opioid dosage.

All bariatric patients in our clinic were treated according to a low opioid anaesthesia protocol. This consists of induction with propofol 2 mg kg^{-1} lean body weight (LBW), fentanyl 100 µg, rocuronium 0,8 mg kg^{-1} LBW, magnesium sulphate 40 mg kg^{-1} LBW, lidocaine 1,5 mg kg^{-1} LBW, dexamethasone 10 mg, ketamine 20 mg, and diclofenac 150 mg. Maintenance of anaesthesia was achieved with sevoflurane at 1.0-1.5 age-adjusted MAC and continuous infusion of lidocaine, magnesium, and rocuronium according to clinical needs. We applied a multimodal non-opioid postoperative analgesia protocol containing paracetamol 2 g, nefopam 20 mg, and tramadol 100 mg 15 min prior to extubation. Monitoring included a 5-lead ECG and measures for heart rate and non-invasive blood pressure. Patients with obstructive sleep apnoea (OSA) or obesity hypoventilation syndrome (OHS) were monitored with an arterial line. Additional monitoring consisted of pulse oximetry oxygen saturation, end-expiratory carbon dioxide ($ETCO_2$), respiratory gases, ventilatory parameters, bispectral index (BIS), and repeated assessment of the neuromuscular block.

Before induction of anaesthesia, every patient was pre-oxygenated with 100% oxygen via a tight-fitting facemask, for 5 minutes at tidal volume ventilation, with an elevated upper body such that the ear level and sternal notch were horizontally aligned. During the induction period, every patient was manually ventilated with CPAP at 10 cm H_2O to prolong the available

time to secure the airway. Laryngoscopy was initiated after the end-tidal oxygen saturation rose above 90%.

The intubation was performed using KingVision^{TM} channelled VL with facilitated viewing by retrograde transillumination.

The intubating personnel assessed and documented the following parameters:

1. Percentage of laryngeal view (POGO score).
2. Visible distinction of illuminated laryngeal structure from non-illuminated neighbouring structures and from the oesophagus (yes or no).
3. Visibility of the glottic entrance according to a subjective visual analogue scale (VAS) (from 0 = 'very poorly visible' to 10 = 'very well visible').
4. Number of necessary introductions of the laryngoscope into the pharynx to achieve success (n).
5. Time to recognise the illuminated laryngeal inlet after insertion of the VL (s).
6. Subjective degree of helpfulness of the IRRIS according to a VAS (from 1 = 'not helpful at all' to 10 = 'very helpful').
7. Subjective degree of credibility of the IRRIS to recognise the correct intubation pathway according to a VAS (from 1 = 'not credible at all' to 10 = 'very credible').
8. Subjective degree of ease of IRRIS handling on a VAS (from 1 = 'very difficult' to 10 = 'very easy').

For the evaluation of intubation performance, the following parameters were documented:

1. Success of video laryngoscopic tracheal intubation within 60 s ('yes' or 'no').
2. Number of intubation attempts (n).
3. Time to conclude intubation from inserting the VL until the tracheal tube cuff was inflated (s).
4. Subjective degree of difficulty of intubation according to a VAS (from 1 = 'very easy' to 10 = 'extremely difficult').
5. In the case of intubation failure: the necessity of employing an alternative airway securing method or aborting tracheal intubation if initial attempt(s) with the IRRIS failed (number and choice of alternative techniques).

After successful tracheal intubation, the IRRIS device was removed and discarded.

Maintenance and emergence from anaesthesia were conducted according to our local protocol and the individual needs of the patient and surgery. Post-operative assessments of the frontal neck's skin condition were performed at 3 periods following removal of the IRRIS device: immediately after removal, 2 hours post-removal, and on the day after surgery.

Data were collected in an electronic spreadsheet that enabled descriptive statistical analysis. Incomplete data were excluded from the analysis. The results are presented as the mean and standard deviation or as the median and interquartile ranges, as appropriate. Normality of data distribution was tested using the Shapiro-Wilk test. Categorical data were reported as frequencies and percentages.

Results

In our cohort, the average BMI was 48 ± 10 kg/m^2. Both neck circumference (48 ± 5 cm) and midline subglottic tissue thickness (12 ± 4 mm) were typical for these categories (Table 1).

The functionality and performance of video laryngoscopy with the addition of retrograde transillumination (IRRIS) resulted in successful intubation in the majority of cases. The details are summarised in Table 2. In two cases, in which the blinking was not visible on the VL display, the reason was attributed to the limitations imposed by the channelled KingVision^{TM} VL. The encountered problems were related to difficulties to introduce the VL into the mouth and consequently to obtain an adequate image on VL screen. These failures cannot be attributed to the functionality of the IRRIS devices.

The performance of the tracheal intubations was highly dependent on the quality of the obtained laryngoscopic exposure. Thirteen intubations succeeded on the first attempt, while 7 others could only be completed during a second attempt. The duration to finalise the intubation procedure - from the insertion of the laryngoscope into the mouth until the tracheal tube was declared to be in place - lasted, on average, under one minute. In one case, the duration to successful intubation lasted 180 s, and this case stood out as the most difficult airway case in the investigated cohort (Table 3).

We found that the degree of obesity correlated with both the time to achieve the best possible laryngoscopic view and the time to conclude the intubation procedure. We found a clear linear correlation of these two parameters with BMI as well as tissue thickness (Figure 1).

During laryngoscopy and intubation, oxygenation was continuously monitored via pulse-oximetry which signalled when airway manipulation had to be interrupted and when it was imperative to resume face mask ventilation (Table 4). Except for 3 patients, the maintenance of normal oxygen saturation was possible throughout the entire procedure. While

the saturation remained unchanged in 12 patients, it increased above the baseline in 5 patients and dropped below the baseline in 3 patients. The lowest oxygen saturation (83%) was observed in the patient with the most difficult intubation, and after 180 s, intubation was successfully completed and normal saturation was restored.

Discussion

Our study evaluates the addition, feasibility, and performance of the novel IRRIS device for retrograde transillumination, which can be used in conjunction with VL individuals with obesity undergoing bariatric surgery present a higher risk of airway-related difficulties and anaesthesia-related complications than lean individuals.[3,4,5] By providing a better view of the airway anatomy and the passageway of the tracheal tube, the primary employment of VL in obese patients with suspected airway difficulties may increase the probability of successful intubation on the first attempt and thus reduce the risk of hypoxemia and other airway-related morbidities.[5,8,17,18]

The IRRIS projects near-infrared light into the tissue of the anterior neck and produces a distinctive blinking from within the tracheal lumen that can be viewed on the VL screen[12,13]. We found this approach particularly useful in obese patients because the IRRIS exclusively highlights the glottic opening, distinguishing the airway from the oesophagus as well as from adjacent structures or mucosal folds which are more prominent in obese patients. Such folds can mimic a false passage for the advancement of the tracheal tube, increase the risk of injury, and might delay the successful conclusion of tracheal intubation.

Our results suggest that in most obese patients (18 of 20), IRRIS provided the expected visual appearance of the correct intubation pathway on the VL screen. Larynx recognition was in average achieved on average within 15 s and tracheal intubation could be completed in less than one minute (Table 2). The subjective assessment on handling of the IRRIS device achieved in average high scores (7 ± 4 for “helpfulness”, 9 ± 3 for “credibility” and 9.6 ± 1.1 for “ease of use”. On the other hand, there was no side effect or problem associated with the use of IRRIS.

As shown in previous prospective investigations[12,13], IRRIS helped in the recognition of the right passage for the tracheal tube earlier than DL without this aid. The blinking light facilitated the distinction of the glottis from disturbing reflections on the airway mucosa caused by the regular light from the VL. Our study answers the question posed in Kristensen’s report[12] as to whether there may be an upper limit in BMI for the usefulness of the IRRIS; for which the answer is that we did not identify such a limit. Additionally, we obtained quantitative results

for both distinctive parameters - neck circumference and anterior cervical tissue thickness and confirmed the ability of the IRRIS to penetrate the abundant anterior neck tissue mass in severely obese patients. The two reported cases where the IRRIS light was not visible on the VL screen were not related to the IRRIS device itself or to the amount of anterior neck tissue. These failures were caused by limitations of the employed VL, where the blades did not match the dimensions of the patients' pharyngeal structures e.g. it was not possible to introduce the VL into the oral cavity and to obtain an image on the VL screen.

The time to recognise the illuminated larynx, after passing the teeth with the VL blade, was similar in obese and lean patients, even with the inclusion of difficult cases.[12,13] Similar to Biro et al's results, the main problems were related to the limitations of the adopted VL. In particular, we experienced that most of the intubation time was used to achieve the best possible position of the VL blade, which was aggravated by the limited mouth opening and larger tongue base in our patients. It was occasionally difficult to lift the epiglottis and bypass abundant mucosal structures at the level of the hypopharynx. A review of 20 reported cases in the literature of oropharyngeal trauma during VL contains such events with other VL devices as well, such as the GlideScope® (Verathon, Inc., Bothell, WA).[19]

Several studies using the GlideScope® have indicated that the ability to view the larynx does not correlate with successful intubation because of the marked angle of the blade[20]. Even with a good view of the larynx, the passage of the tube into the trachea may still be difficult.[21,22] The GlideScope® does not require alignment of the three airway axes (oral, pharyngeal, and tracheal), and the tracheal tube must be introduced around the curve of the blade.[23,24,25,26] To overcome this problem, the tracheal tube is often pre-shaped with a malleable stylet to an angle of 60° to 90° that follows the curvature of the GlideScope® blade. Tracheal intubation can cause various acute airway injuries including arytenoid subluxation, supraglottic or glottic haematoma, laceration of the glottic mucosa and vocal cord, tracheal rupture, and mediastinal emphysema.[27]

Retrograde transillumination with the IRRIS showed superior tissue penetration compared to other devices such as lighted stylets[28] (Davis 2000) which use the 'light from inside out' method. Therefore, the blind nature of the lightwand technique makes it less suitable in cases of airway pathology, friable tissue, and anatomic distortion. In overweight or obese patients (i.e., $BMI \geq 25\ kg/m^2$), the intubating time in lightwand-assisted endotracheal intubation is significantly increased. Other authors have also reported the failure of lightwand-assisted intubation in overweight patients.[29,30,31,32] Some authors have proposed the use of visible light in a retrograde direction (applied through the skin of the anterior neck at the

cricothyroid membrane), as a useful technique in patients with normal airway and BMI ≤ 30 kg/m^{2,} for conventional laryngoscopy and intubation.[33,34] Hudson et al. described a retrograde trans-tracheal illumination of the glottis, as a rescue technique to facilitate tracheal intubation, which uses a flashlight for visualisation of the oropharyngeal structures and glottis, in unsuccessful DL cases. Compared with DL, the success rate was greater in the retrograde transillumination group for all five intubations (72% *vs.* 47%; rate difference, 25%; 95% CI [11.84–38.16%], $P < 0.001$). This was associated with a shorter time to glottic exposure in the transillumination group (27 s [15; 42] *vs.* 45 [30; 73] s, $P < 0.001$), shorter intubation time (66 [44; 120] *vs.* 120 [69; 120] s, $P < 0.001$), and decreased throat soreness.[34] All these times were longer than those of the IRRIS group.

The parameters reflecting the IRRIS performance were distinctly positive. Besides the mentioned shorter larynx recognition time, we needed one VL insertion attempt for successful viewing in 13 out of 20 cases (65%) and 2 insertion attempts in 7 cases (35%). In accordance with other authors, we also emphasise the paramount importance of first-pass success in tracheal intubation especially in obese cases due to the increased likelihood of having a short safe apnoea period.[5,35,36,37,38]

Conclusions

We conclude that the IRRIS is suitable and useful for retrograde transillumination of the larynx in extremely obese patients. If it is used in conjunction with a suitable VL device, the larynx becomes more distinguishable on the VL screen and the intubation pathway is clearly visualised. This blinking is observed, solely, as coming outward from the trachea, in contrast to adjacent structures such as the oesophagus or mucosal folds which remain dark.

WHAT IS KNOWN

- It has been demonstrated that the Infrared Red Intubation System (IRRIS) is a reliable technique that facilitates the identification of the glottis and the intubation pathway during video laryngoscopy. This has been described in lean patients.

WHAT IS NEW

- Our study showed the IRRIS is useful for video laryngoscopic intubation by applying retrograde laryngeal transillumination in obese and extremely obese patients such that the intubation pathway is clearly visualised on the VL screen.
- The IRRIS causes blinking from the trachea, as seen on the screen of the video laryngoscope, and this clearly distinguishes the airway from the oesophagus and adjacent anatomical structures. Even extreme obesity, with a longer distance from the skin surface to the tracheal lumen, is no hindrance to the functioning of the retrograde transillumination effect.
- Highlighting the airway during video laryngoscopy may simplify and shorten the intubation procedure, thus leading to a higher success rate in securing the airway. In particular, obese patients may benefit from a higher first-pass success rate, which might reduce morbidity due to desaturation and/or injuries by prolonged manoeuvres to conclude tracheal intubation.

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NOTES

Conflicts of interest

Peter Biro is Medical Adviser in Guide In Medical (Nazareth, Israel).

The authors DG, CC, MA certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Contributors-

DG: Contributed equally with PB to plan the study, performed and supervised the clinical investigations, and wrote parts of the manuscript including the final revision of the manuscript.

CC: Manuscript revision.

MA: Performed clinical investigations.

PB: Had the original idea to perform this investigation in a dedicated bariatric surgical unit, contributed equally with DG to plan the study, and wrote parts of the manuscript including the final revision manuscript.

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TABLES

Table I. Biometric characteristics of the investigated patient population (n = 20).

a. Numeric parameters	**Number (percentage)**	
Gender distribution	8 females (40%), 12 males (60%)	
ASA class	ASA 1: 1 (5%), ASA 2: 14 (70%), ASA 3: 5 (25%)	
Mallampati grade	Grade 1: 4 (20%), Grade 2: 7 (35%), Grade 3: 8 (40%), Grade 4: 1 (5%)	
b. Continuous parameters	**Mean (±SD)**	**Median (range)**
Age (years)	39.8 (±15)	39 (15 - 64)
Height (cm)	174 (±10)	174 (157 - 199)
Weight (kg)	145 (±29)	138 (100 - 198)
Body Mass Index (kg m^{-2})	48 (±10)	45.5 (35 - 66)
Neck circumefernce (cm)	48 (±5)	48 (38 - 60)
Suprasternal median tissue thickness (mm)	12 (±4)	11 (6 – 20)

Table II. Functionality and performance of the IRRIS device during video laryngoscopic intubations with the channelled KingVision™ video laryngoscope.

a. Numeric parameters	**Number (percentage)**	
Number of initially functioning IRRIS devices	20 (100%)	
Number of visibly illuminated larynx	18 (90%)	
Number of laryngoscopy attempts	1 att.: 13 (65%), 2 att.: 7 (35%)	
Number of excellent (exc), sufficient (suf) and unsuccessful (uns) video laryngoscopic exposures of larynx	exc 14 (70%), suf 4 (20), uns 2 (10%)	
b. Continuous parameters	**Mean (±SD)**	**Median (range)**
Time to larynx recognition (s)	15 (±13)	10 (2 - 50)
Visualization quality (VRS: 1 low -10 high)	9 (±3)	10 (1 - 10)
Degree of helpfulness (VRS: 1 low -10 high)	7 (±4)	10 (1 - 10)
Degree of credibility (VRS: 1 low -10 high)	9 (±3)	10 (1 - 10)
Ease of use and handling (VRS: 1 low -10 high)	9.6 (±1.1)	10 (7 - 10)

Table III. Intubation performance, using a KingVision™ video laryngoscope with channelled blades and an activated IRRIS device (att. = attempt).

a. Numeric parameters	**Number (percentage)**	
Number of intubation attempts	1 att.: 13 (65%), 2 att.: 7 (35%)	
b. Continuous parameters	**Mean (±SD)**	**Median (range)**
Intubation duration (s)	54 (±35)	50 (10 - 180)
Degree of difficulty (VRS: 1 easy-10 very difficult)	2 (±1)	2 (1 - 7)

Table IV. Behaviour of pulse-oximetry saturation during the management of the airway.

a. Numeric parameters	**Number (percentage)**	
Number of SpO_2 changes during airway management	decreasing: 3 (15%), unchanged: 12 (60%), increasing 5 (25%)	
Number of (hypoxemic) SpO_2 <90%	1 (5%)	
b. Continuous parameters	**Mean (±SD)**	**Median (range)**
Baseline SpO_2 (%)	98 (±2)	98 (91 - 100)
Lowest SpO_2 during airway management (%)	97 (±4)	98 (83 - 100)
Maximal SpO_2 change from baseline (%)	0 (±4)	0 (0 - 16)

LEGEND FOR THE FIGURE

Figure 1. *Linear regressions of laryngoscopy and intubation durations with BMI and tissue thickness.* The correlation coefficients for video laryngoscopic recognition time was: (1) LR Time vs. BMI (L_{time} = 0.3375 BMI -1.449) and (2) LR Time vs. tissue thickness (L_{time} = 1.214 Tissue + 0.4593). The correlation coefficients for intubation duration was: (3) Intubation time vs. BMI (I_{time} = 1.036 BMI +5.034) and (4) intubation time vs. tissue thickness (I_{time} = 1.074 Tissue + 41.79)